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# PROBLEM ANALYSIS VALUATION OF WILDLIFE AND FISH RESOURCES IN THE NATIONAL FOREST SYSTEM: PART B OF PROBLEM ANALYSIS FOR PROBLEM 3: TECHNIQUES FOR NATIONAL ASSESSMENTS OF WILDLIFE AND FISH

# PROBLEM ANALYSIS

# VALUATION OF WILDLIFE AND FISH RESOURCES

# IN THE NATIONAL FOREST SYSTEM

Part B of Problem Analysis for Problem 3:

Techniques for National Assessments of Wildlife and Fish

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# PROBLEM ANALYSIS:

# VALUATION OF WILDLIFE AND FISH RESOURCES IN THE NATIONAL FOREST SYSTEM[1]

## SECTION I. INTRODUCTION

The purpose of this document is to recommend general priorities for a program of research in the valuation of wildlife and fish resources focused on the amelioration of problems faced by the National Forest System of the USDA Forest Service.

The National Forest System (NFS) requires knowledge of the values associated with wildlife and fish resources in order to partially accomplish two major and integrated tasks:

1. The preparation of long-range plans mandated by the Forest and Rangelands Renewable Resources Planning Act of 1974 (RPA) as amended by the National Forest Management Act of 1976 (NFMA) and as defined in the implementing regulations of 1979; and
2. Annual budgeting, which determines the extent to which planning will be implemented.

In order to allocate scarce research resources in the most efficient and useful manner to facilitate these tasks, it is necessary to examine the adequacy of current knowledge in planning and budgeting. A lack of adequate knowledge

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[1]Acknowledgement is made of substantive individual comments on an earlier draft by Thomas Shiflet of the Soil Conservation Service, John Loomis of the Fish and Wildlife Service, and Roger Fight, Con Schallau, Ervin Schuster, and Lawrence Garrett, all of the Forest Service.

about the values associated with wildlife and fish (WL/F) resources leads to significant impediments to carrying out these tasks. Bases for judging that impediments exist and their relative importance include the historical record of valuation-related uncertainties, delays and controversies, judgments by agency staff groups and individuals about difficulties to be expected in the future in the absence of more complete knowledge and its effective presentation, and logical comparison between those findings and the current and prospective state-of-the-art of valuation.[2]

The focus of this document is on the measurement of the degree of enhancement (benefits) of society's welfare in the long run due to WL/F-centered activities of NFS. The National Environmental Policy Act and other legislation make clear that enhancement in long-run welfare can only be measured by utilizing several kinds of indicators that are often subsumed in analytical models focused on economic efficiency, social impacts and ecological or environmental effects. Because of the relative state-of-the-arts of these alternative models, the conventional analytical approach is to directly conduct economic efficiency analyses, which explicitly or implicitly include an objective function posited to be consistent with society's fundamental welfare function, and to report consequent changes in other kinds of indicators. Establishing values is a necessary preliminary to conducting efficiency analyses.

In order to meet legal and administrative requirements to provide alternatives for political decision-making and funding, planning and budgeting processes that define the kinds of data that must be compiled have been established.

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[2]Most of the observations and definitions of specific problems in this paper have not previously been documented. They are based on the writer's experience, as modified during the review process.

Section II of this Problem Analysis discusses these processes as applied to NFS, first in general terms of the intent of these processes and then with a focus on the actual treatment of values associated with wildlife and fish resources. The purpose of these discussions is to define known and possible problems (indicated by underlining) in compiling valuation-related data.

Those readers not concerned with the planning and budgeting processes of NFS or the rationales for problem identification can go directly to Section III, for the identified problems are restated in logical groupings there. Anticipating that section, the major categories of problems are defined as:

-- Lack of convincing methodologies for valuation,

-- incomplete understanding of the implications of current procedures and estimates,

-- sharply limited availability of empirical estimates, and

-- inadequate internal training and external communication.

In Section III, the research and other actions necessary to correct or ameliorate each problem are discussed. Where appropriate, the research and/or applied state-of-the-art of valuation is reviewed and assessed.

Finally, in Section IV, general priorities are defined for a program of research focused on relieving these problems.

# SECTION II.

# PROBLEMS OF VALUATION IN NFS PLANNING AND BUDGETING

## Problems in Planning

### General Planning Process

The major components of the NFS planning process are displayed in Table 1. The right-hand column identifies the critical definitions made at each hierarchal level.[3] Each of these definitions is partly based upon the values perceived to be associated with wildlife and fish resources.

National Forest System resource output targets, and policies to achieve those targets, are defined in the national RPA Program. Regional plans translate the policies into technical standards and guidelines appropriate for particular subnational physical and socioeconomic conditions and suggest ranges of output levels that should be examined during planning on individual Forests.

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[3]Considerable overlap, coordination and negotiation occurs among hierarchal levels. This is necessary in any interactive and geographically dispersed data-generating process that must be extensively supplemented with professional judgments. See Cortner and Schweitzer (1981; in process) for more complete discussions of the planning process and of problems likely to be encountered in its implementation.

Table 1. - Major components and decisions of the NFS planning process

| Component | Decision/definition |
|---|---|
| 0. (Previous Cycle) | |
| 1. National RPA Assessment | 1.1 National situation, needs, opportunities |
| 2. National RPA Program | 2.1 NFS share of needs, opportunities<br>2.2 Output targets or ranges of targets<br>2.3 Policy direction |
| 3. Regional Plans | 3.1 Technical translation of policy to standards, guidelines |
| 4. Forest Plans | 4.1 Basis for choice: issues, concerns, decision criteria, alternatives<br>4.2 Technical definitions:<br>-Constraints<br>-Management prescriptions<br>-Production functions<br>-Production costs<br>-Issues, concerns, targets<br>4.3 Evaluation:<br>-Efficiency<br>-Impacts<br>-Effects<br>-Implications to targets, issues, concerns<br>4.4 Choice of plan |
| 5. Budget Requests | 5.1 Implementation<br>5.2 Monitoring<br>5.3 Replanning |

Given this guidance, individual Forests must define:

-- criteria for chosing a plan

-- alternative plans

-- Forest-specific constraints necessary to meet all directives

-- production possibilities within those constraints[4]

-- the "goodness" of alternative plans, and

-- the best plan.

The final steps are to initiate budget requests based on the plans, implement the plans to the extent budgeted, monitor the results and, eventually, replan.

Planning Regulations require that the preferences, needs, and objectives of other Federal agencies, of state agencies, and of interest groups and individuals be considered. Because land management planning must be responsive to these inputs, clear communication of all aspects of the process is critical.

Treatment of WL/F Values

In principle, the values associated with WL/F resources can be analytically recognized in two ways: (1) through the explicit calculation of dollar and dollar-equivalent values for commercially and recreationally important WL/F resources, respectively, and (2) through the establishment of constraints (perhaps without concern for any formal valuation process) that require achieving minimum WL/F output targets and/or providing some level of protection to the resources. These values may also be reflected in implicit constraints on the definition of acceptable management prescriptions during the Forest-level analytical process and always are considered in a non-analytical fashion during the political decision processes that actually select national Programs and individual Forest plans.

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[4]Wider ranges of estimates are required for national-level (Assessment and Program) consideration in subsequent planning cycles.

Explicit valuation.--During formulation of the RPA-80 Program, broad estimates of the average dollar-equivalent and dollar values of major WL/F-dependent recreational and commercial activities were defined, based on a review of published studies from across the nation.[5] These broad estimates were mandated for use in all Forest planning except where Forest-specific studies (consistent with Water Resources Council Principles and Standards) were available or where adjustments were necessary to avoid unreasonable differences in adjacent Forests administered by different Regions. It is known that both entire Regions and individual Forests have utilized the "exception clause," but there is no central record or monitoring of the values actually being used in planning (B-1).[6]

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[5]See Schweitzer et al. (1980) for a critique of the original values and recommended changes. Revised values were sent to Regional Foresters in a 1920 letter of 2/24/81 entitled "Unit Values to be Used in Forest Planning" by Deputy Chief for NFS. A similar process was used to value other extramarket resources. Because the studies basic to the RPA values varied greatly, the degree of commensurability in valuation among extramarket resources and between those and marketed resources is unknown (B-2).

[6]In this section of the paper, a valuation-related problem is identified by underlining. The parenthetical letter-number code is a cross-reference to discussion of its amelioration in Section III.

Because of the present, very early stage of the Forest-level planning process, conprehensive sensitivity analyses have been infrequent. As a consequence, it is unknown whether changes in current (RPA-mandated) WL/F values would have any effect on FORPLAN results (B-1). That is, the analytical payoff of refining current estimates may be great or small.

During development of the RPA-80 national Program, the average values were rejected by USDA and OMB as unsuitable for analytical purposes. Simple guesses replaced any attempt to analytically equate marginal revenues to marginal costs in defining an efficient Program (except in the case of timber). Although this situation might be improved in part by calculating values through improved methodologies, it is likely that the traditional focus on cash-flow economics will continue in the absence of much more convincing evidence of the logic of extramarket valuation procedures than is now available (A-1).

At the time of the RPA-80 process, there was no alternative to relying on difficult-to-defend estimates of average values, for "better" data did not exist. This situation has not improved for extramarket resources. Cost, time, and expertise requirements of most valuation methodologies make them infeasable for wide-spread application on the National Forests (C-1).

Regardless of the rationales and precise unit values the Forest Service has attributed to WL/F-dependent recreation, state wildlife and fish agencies have seldom accepted NFS estimates of value. To this point, the agency has not effectively explained the logic or range of techniques by which values of wildlife and fish are considered in planning (D-2).

Output targets.--National output targets or ranges of output targets for individual resources are established during development of the national Program. RPA-80 was the first time that output targets directly related to numbers of animals had ever been established for wildlife and fish resources. They were

expressed in terms of "habitat capability indexes," which were intended to be expressions of (potential) average future population levels in the mid-1990's relative to average population levels supported by NFS habitat in the late 1970's.

While the establishment of such targets reflects an effective concensus that WL/F management should plan to produce specified levels of benefits to society defined in terms of potential populations, available data limited translating these targets into actual (rather than relative) numbers of animals to salmon, steelhead trout, and six big game species. Although all of these species are highly prized for recreational and/or commercial purposes, explicit benefit-cost comparisons played essentially no role in the target-setting process. In part, this was because very few empirically based economic demand schedules for WL/F have been developed at the Forest level; none exist at the Regional or national levels (C-2).[7]

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[7]The attention given WL/F resources has traditionally depended upon political, rather than analytical, processes. During the 1970's these resources prospered. It is likely that their fate in the future will be more highly correlated with the availability of hard evidence that they provide measurable benefits. The only quantitative projections contained in the RPA-80 Assessment were for WL/F-dependent recreation; they simply extrapolated past (rising) trends in use on the basis of expected population and age-cohort changes. For discussions of the availability of analytically useful data and a critique of past Assessments, see Schweitzer (1980) and Schweitzer et al. (1981).

It is important to note that national targets were limited to population levels of high-interest species. No targets were established for habitat favoring "minor" species or for desired levels of diversity. Yet both the maintenance of viable populations of all vertebrates and of habitat capable of supporting the existing diversity of species are significant requirements of land management planning and require substantial expenditures. Many objectives of wildlife management never are treated within an economic context; our ability to establish values of alternative faunal and habitat conditions is sharply limited (C-3).

Constraints.--Given the analytical model used in Forest planning (FORPLAN), it is necessary to translate requirements to satisfy targets, protective standards, public issues and management concerns into either (1) explicit minimum/maximum constraints on the analytical solution space (see Mealey and Horn 1981), or (2) implicit constraints, typically by filtering out certain activities from the set of management prescriptions that are explicitly examined.[8] While individual Forests have carried out sensitivity analyses, no comparative analysis has yet been conducted of opportunity costs imposed by alternative methods of defining WL/F protective constraints (C-4). No one has determined the extent of implicit, WL/F-favoring constraints or their implications (B-1).

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[8]No Forest has chosen to represent such requirement (for WL/F) in objective functions.

Production functions.--The FORPLAN model requires definition of:

-- managerial inputs, in the form of management prescriptions and (integrated-across-resources) costs,

-- acreages (stratified by physical productivity and managerial considerations),

-- physical responses to inputs, and

-- values per unit output.[9]

There is reason to question the validity of the estimated relationships between cost inputs and WL/F-dependent recreation output values (B-3). Critical reviews of preliminary budget data for Wildlife and Fisheries Management (exclusive of T&E and "coordinated" management) suggest there are wider differences in estimates of production, use and value functions among Regions than would be expected on the basis of physical and socioeconomic differences. Since these budget data are region-wide averages, differences among individual Forests must be still greater.

Evaluation.--To the extent that WL/F production functions are incorrectly specified, differences among plan alternatives may be misestimated. Assuming consistency of estimation (that is, a constant bias) among alternatives on each Forest, over- or under-budgeting of the chosen plan in total and an inappropriate balance among resources are still possible.

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[9] A second approach is to estimate potential changes in WL/F-dependent recreation values through a series of projections of Recreation Information and Management (RIM) data based on the differing land allocations by Recreation Opportunity Spectrum (ROS) class which are inherent in plan alternatives. Although calculation of the opportunity costs or shadow prices of WL/F is a useful means of analyzing forest-specific plan alternatives, explicit values are still required for aggregated Regional and national planning and budgeting.

Choice of plan.--The decision process that judges alternatives by numerous criteria is generally assumed to compensate for short-comings in any particular analysis. This may not be true. For example, the appropriate definition and treatment of public issues might translate (local) cultural values into technical terms such as "preserve all winter range for elk." Whether such translations capture the essence of issues is simply unknown. To this point, the process of choice that leads to a final plan, as opposed to the analytical process, has not been subjected to close scrutiny (B-5); the appropriateness and influence of alternative weightings in recognition of WL/F values is unknown.

## Problems in Budgeting

### General Budget Process

The general steps in the budget process are presented in Table 2.[10] Within the context of Forest plans, individual, on-the-ground projects are identified. It is at this point (or, less desirably, at the Regional level) that critical estimates of costs, benefits and effects are made and entered into the budgeting system. When aggregated, these data form the primary basis for efficiency analyses of alternative budgets by type of project at all hierarchal levels.

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[10] In fact, the process is much more complex than indicated; negotiations, analyses and revisions of estimates occur repeatedly during the approximately 2-1/2 years required to put together a budget.

Table 2. Hierarchal framework of budget process.

| Step | Hierarchal Level | Principal Activities |
|---|---|---|
| 1. | Forest | Project definition |
| 2. | Region | Application of across-resource budgeting strategy |
| 3. | WO | Analysis of Regional data<br>Target, cost negotiations with Regions |
| 4. | USDA | Economic, budget, political analysis<br>Negotiations with agency |
| 5. | OMB | Fit to President's budget<br>Economic, political analysis |
| 6. | Congress | Political negotiations<br>Occasional economic analysis |

All proposed projects are summarized at the Regional level. Because many objectives can be reached through multiple use activities, the Region can adopt a variety of budgeting strategies. For example, where improvements in both wildlife habitat and timber growing conditions are of concern, there frequently is latitude to specify the "major" purpose of an activity as either timber management or wildlife management. The project can be primarily funded under the function having the primary interest and the other function given that fewer number of dollars required to provide support.[11]

The WO analyzes the aggregated budget data to judge likely achievement of national targets, economic efficiency, and budget requirements. Expected outputs and costs are compared to RPA Program directions and to preliminary budget "marks" defined by OMB. Necessary adjustments are negotiated with the Regions.

Review at USDA is the first time the proposed budget is completely exposed to political operatives of the Administration. With specific exceptions that change over time, regional employment and other economic impacts are not as important at this level as the size of the budget requirements and estimates of economic efficiency.

The determination of the President's budget request by OMB, again, is largely based on national budgetary requirements and economic efficiency. Congress tends to be more concerned with regional economic impacts of proposals,

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[11]For example, R-3 relies principally on timber projects to enhance wildlife habitat, while R-2 relies more heavily on WL projects to improve timber growing conditions.

but it occasionally questions both economic efficiency and non-economic program implications.[12] Eventually, a final budget is defined.

Treatment of WL/F Values

The requirement that data be aggregated for analysis at several hierachal levels poses several difficulties for valuation of all resources. Current agency data systems do not provide an adequate basis for any analysis except efficiency analysis; any other consideration of costs or benefits, such as secondary impacts on local communities, are dependent upon "special studies." Of more direct interest in the present context, the definitions of economic efficiency in planning and budgeting are not consistent (B-4). Forest plans by Regulation are to include that set of all activities that is most cost-effective in meeting Forest objectives. In contrast, budget analyses at the national level are always by individual line item (or by a variant called an "element"). The analytical (as opposed to political) criterion in budgeting is an absolute one of PNW >0, without regard to individual Forest objectives and with no analytical tie to any other line item. The most appropriate

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[12]Because the agency budget is much less than 1% of the total national budget, searching analyses are infrequent. One exception has occurred in the relatively large fire management budget; a Congressional directive in 1978 led to the agency's development of a national budgeting system in that area. Although analytical data had never provided an adequate basis for decisions based on economic analyses, FY 81 was the first time in 10 years that Congress did not provide an "add-on" to the Wildlife and Fisheries Management budget above the President's budget request.

allocations of joint costs and to individual functions are uncertain. (Efforts to define the RPA-80 Program as a multiple-use Program failed from an analytical perspective; because the Program in its entirety was too complex to deal with in the decision-making process, economic analyses were either by line items or elements or were not made at all.)

There are four sub-functions in Wildlife and Fisheries Management budget; all benefits and costs must be displayed and evaluated within these categories in the budgeting process. They are:

-- enhancement of wildlife habitat

-- enhancement of fisheries habitat

-- enhancement of habitat of T&E animals, and

-- planning, maintenance of improvements, and support to other functions.

The only management benefits to which dollar values have been ascribed are those that enhance WL/F-dependent recreational and commercial activities. All other expenditures are justified on the basis of meeting some mandated physical condition, guideline or protective standard or to improve the condition of T&E species. Standards and guidelines have seldom been subjected to explicit analysis; trade-off costs and the efficacy of alternative standards and guidelines are seldom known (C-4).

Current budget data show wide variations among Regions in costs to the WL/F budget of supporting timber sales. Such variations could be due to on-the-ground differences, differences in estimating procedures and accuracy, and/or different approaches to using the budget system. Any differences in estimating procedures or in the way the budget system is used lead to problems in determining the relative desirabilities of alternative national programs of work.

As a partial basis for developing the RPA-80 Program, present net worths were calculated for a wide variety of proposed direct habitat enhancement projects. The summary in Table 3 shows that about two-thirds of the proposals would have a positive present net worth. It is unknown whether the wide variations among Regions are due to differing biological or socioeconomic conditions or to inconsistencies or inaccuracies in reporting (B-3). Some part of the variation may simply be due to an inability to express any benefits beyond those associated with direct human use.

Table 3. Proportions[1] of RPA-80 Program proposals for wildlife and fish habitat improvement that were and were not estimated to be economically efficient, by Regions

| Region | Present net worth | |
|---|---|---|
| | PNW ≥0 | PNW <0 |
| 1 | 48% | 52% |
| 2 | 6 | 94 |
| 3 | 50 | 50 |
| 4 | 82 | 18 |
| 5 | 45 | 55 |
| 6 | 53 | 47 |
| 8 | 100 | 0 |
| 9 | 79 | 21 |
| 10 | 88 | 12 |
| NFS | 63% | 37% |

[1]Based on estimated FY 81 costs totalling $35 million. An additional proposed expenditure of $18 million was defined as the "zero-base" and not subjected to explicit analysis.

## SECTION III.

## RESTATEMENT OF VALUATION PROBLEMS AND NEEDED ACTIONS

The known and likely valuation-related problems impeding planning and budgeting in NFS can be categorized as those stemming from:

-- a lack of convincing methodologies for valuation of WL/F resources,

-- incomplete understanding of the implications of current procedures and estimates,

-- sharply limited availability of empirical estimates, and

-- inadequate internal training and external communication.

Individual problem statements are given below with discussions of the role that WL/F-oriented valuation research might play in the resolution of each. Assessments of the state-of-the-art are included where appropriate. The problems and types of needed actions are broadly summarized in Table 4.

Table 4.--Problems, Action Needed for Resolution, and Probable Role of Valuation Research.

| Identified problem | Needed action | Probable role[1] |
|---|---|---|
| A.1. Lack of convincing methodologies | A.1. Conceptual document, methodology validation | A.1. Lead research |
| B. Incomplete understanding of current procedures | | |
| 1. LMP values and treatment | B.1. Summary, sensitivity analysis | B.1. Coop. research--LMP |
| 2. Commensurability of values | B.2. Summary, test (conceptual document) | B.2. Coop. research--RPA,NFS |
| 3. Variation in field data | B.3. Detailed comparisons | B.3. Admin. study--WL/F |
| 4. Integrated/functional linkages | B.4. Test alternatives | B.4. Admin. study--NFS, PD&B |
| 5. Total decision process | B.5. Specification, sensitivity analysis | B.5. Admin. study--LMP,NFS |
| C. Limited empirical estimates | | |
| 1. Lack of feasable methodologies | C.1. Develop secondary data methods | C.1. Lead research |
| 2. Lack of hierarchal demand functions | C.2. Define functions and hierarchal relationships | C.2. Lead research |
| 3. Limited scope of measurement | C.3. Define methodologies | C.3. Lead research |
| 4. Unknown cost/efficacy of standards | C.4. Define opportunity costs, measures of efficacy | C.4. Lead research |
| D. Inadequate training, communication | | |
| 1. Internal training | D.1. Develop standards; training | D.1. Compile information |
| 2. External communication | D.2. Technology transfer | D.2. Compile information |

[1]Administrative ("admin.") studies differ from research studies in that their analytical focus is on description and near-term implications of alternatives rather than on the rigorous formulation and testing of scientific hypotheses.

## Problem A.1. Lack of Convincing Methodologies

Values estimated for WL/F resources have been routinely challenged without effective response during within-government review of planning and budgeting and during political decision processes and critiques at local and national levels (e.g., Society of American Foresters 1981). While there have been identifiable technical shortcomings in past estimates, even full application of state-of-the-art techniques is unlikely to prove convincing. There are two related research steps required if any value estimates of extramarket resources are to be generally accepted as comparable to values of marketed resources. The conceptual reasoning underlying valuation must be presented in a manner that is intelligible to the general (i.e., nonspecialist) analyst, and valuation methodologies must be validated. The entire burden of proof is on those who would establish such values.

### Conceptual Reasoning

Because the valuation of extramarket resources is a relatively new field, many important concepts appear in the scientific literature only as fragments of thought. There exists no single, rigorous treatise laying out the entire train of logic (and the underlying assumptions) that leads from the notion of an aggregate social welfare function to the nonobvious conclusion that separately determined estimates of values of extramarket and marketed resources can be combined in a single calculus to define the relative values or efficiencies of alternative sets of production activities. Possibly as a result, there is no single "interpreted" document that is convincing to those analysts who are most influential in policy and budget making or that provides the necessary intellectual support to agency representatives. Preparation of such a document is needed.

Validation of methodologies

While intense examination of the reasoning process underlying extramarket resource valuation, particularly in the past 15 years, has gradually led to a concensus among specialists that the major strands of reasoning are, in fact, logical, empirical results have not yet been convincingly shown to be consistent with that reasoning. It cannot be said that existing empirical techniques have been rigorously validated either on the basis of (1) reproducible results or (2) successful prediction of observable facts.

It has been argued by some that extramarket valuation study results are similar enough to conclude that empirical techniques are "reasonable." The argument is not scientifically satisfying for two, related reasons. To claim validity on the basis of reproducible results requires both that the same technique be applied and that different applications be independent. On the first point, it is commonly acknowledged that constructing demand functions is still largely an artistic endeavor that requires specialists with a "feel" for the technique to deal with subtle differences in the raw data and questions of interest. For example, logical inconsistences introduced by inaccurate statements of intent in responses to questioning have been noted by Schuman and Johnson (1976), and the influence on results of inconsistent treatment of "unusual" responses and of selection of regression functions to define travel cost decay functions have been noted by Myer (1979) and Gum and Martin (1975), respectively. Neither the selection of data for analysis nor the processing of data have followed rigorously defined algorithms or tested the same scientific hypothesis in successive applications of valuation techniques; indeed, no one has enough experience to know whether standard algorithms can reasonably be constructed for application to diverse situations. Unfortunately, Bishop and Heberlein (1979) and Smith (1980) have reported that their personal applications of different empirical measurement techniques to the same situations gave widely different results.

The other criterion for true reproducability of results, that of independent applications, may not have been met either. The common measure of "reasonableness" of results is whether they are similar to results obtained by others. It is likely that, in many cases, the agreement of tentative results with those obtained in earlier studies is required before releasing study conclusions. To the extent this is true, such results cannot, of course, be used as evidence of consistency among studies.

The above is consistent with a generic description of newly evolving areas of invesigation that still contain both conceptual and empirical challenges. One signal that this is, in fact, the situation is that essentially no attention has been paid to developing inference procedures so that statistical measures of credibility of demand functions can be rigorously defined.

The ultimate criterion of achievement for any area of investigation is the successful prediction of observable fact. Valuation of extramarket resources has not demonstrated this capability, partly because major efforts have focused on the question "what would the price be if there were a price?" That is, what is sought has been defined as being other than an observable fact. While this may be an obstacle that cannot be overcome in general, there are at least three approaches that could provide a more convincing basis for strong inferences that empirical techniques produce results consistent with reality: (1) impose a market system on public recreation; (2) extrapolate the results of private sector pay-for-use recreation to public sector free-use recreation; and (3) apply the methodologies used in extramarket valuations to marketed commodities.

The only published study imposing a market system on (public) wildlife or fish recreation is that by Bishop and Heberlein (1979). Essentially, they subdivided one population of goose hunters into three parts and, through

actual cash offers, determined actual willingness-to-sell prices (WTS). Average hypothetical willingness-to-pay prices, depending upon the methodology and assumptions, ranged from $11 to $45; actual WTS averaged $62; hypothetical WTS averaged $101. As the authors state, much more cross-checking with market transactions is necessary before practitioners of recreation valuation "can claim accuracy comparable to analyses of market phenomena."[13]

Obvious constraints on experimentally charging for recreation are political feasability and, on purchasing rights to recreation, the costs (more than $12,000 was given for hunting permits in the above). Therefore, with the exception of observing what happens in the event of fortuitous changes, such as increases in gasoline prices or in license fees (i.e., acquisition costs, after Schuster 1977) or in politically acceptable site fees, validation will have to rely heavily on logical inferences.

Because numerous private owners of land sell hunting and fishing rights, it may be possible to define economic demand functions for those rights (e.g., King and Walka 1980). It may also be possible to define similar situations on public lands and to infer the nature of economic demand, based on private sector functions. This would appear to be possible either through the traditional approach of focusing on site-specific recreation (users from different origins) or through attribute (hedonic) pricing where recreationists come from a single origin and, say, public-fishing and private-fishing are viewed as qualitative differences of the same experience. Inferences from private to public sectors have not been reported in a manner adequate to construct public sector demand functions.

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[13]The final comment by Schulze et al. (1981) that "Such information, in our view, is preferable to complete ignorance" is not inconsistent with this assessment of the state-of-the-art.

The third possible approach is to apply the methodology to marketed commodities. The traditional arguments encountered have been that, for common commodities such as golf or baseball games, there is not enough variation in travel costs to construct a demand function; for less common commodities where some users travel long distances, studies must be confounded by joint-product experiences (e.g., holiday skiing at Aspen) or by strategic behavior associated with buyers' market positions (e.g., stumpage purchasers on the National Forests). Neither argument, unfortunately, provides a basis for faith that demand functions for extramarket resources can be defined; the second argument suggests that demand functions for market resources (at least at the Forest level) cannot be estimated in a satisfactory manner.

## Problem B. Incomplete Understanding of Current Procedures

The current planning systems and the underlying analytical procedures and data elements are quite new to the Forest Service, even though an evolution can be traced from functional timber plans, early approximations to PPBS, and other endeavors. As a consequence, current estimation of WL/F values and analytical manipulations frequently do not follow standard procedures. Given knowledge of what has been done, there is an opportunity to identify the best approaches, to establish guidelines based on those approaches, and to more precisely determine how scarce research resources might best be applied.

Such a process of review and synthesis can sometimes be utilized as an integral component of, or as a preliminary step in conducting, traditional research, that is, the rigorous formulation and testing of scientific hypotheses. As a minimum, the past provides experimental data; frequently, the quality of those data can be defined.

### B.1. Values and their treatment in planning

The first need is to identify and synthesize value data that have already been developed in the land management planning process. These data should be sorted into those which are suitable for future use when appropriately modified and those which are not, and the circumstances of their derivation determined. This information can then be used to determine the requirements for ensuring that credible values are used in second-round planning.[14] Testing of the sensitivity of FORPLAN and plan-selection results to those values will give an indication of the practical importance of devoting research efforts to refinement of valuation methodologies.

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[14]For example, if the quantity of economic expertise needed can be estimated, an appropriate administrative strategy can be formulated. Such requirements are neither obvious nor trivial. Early 1978 estimates that 50 economist-years

The information generated through synthesizing and evaluating the values and procedures now used in land management planning would also be of value in addressing the other specific subproblems listed under Problem B and in determining the costs and benefits of alternative protective standards (Problem C.4., below).

B.2. Value commensurability

To the extent that criteria for ensuring that resource values are comparable are defined in resolution of problem A.1., above, the task here would be simply to summarize current estimates and test them against those criteria. If A.1. were approached strictly in a functional context, the logic for market-extramarket comparisons would have to be developed here. The research question focuses on logic, criteria and methodologies. The application question focuses on whether estimates are "good enough" to be credible.

B.3. Variation in field data

As the application of valuation procedures to wildlife and fish resources becomes more important to planning and budgeting, evaluation of current data becomes more critical as a means of ensuring credibility. Given the uncertainties inherent in tracing production functions from management inputs to changes in habits, populations and uses, a structured review and comparative analysis could form the basis for standardized procedural guidelines for data development.

B.4. Linkages between integrated and functional analyses

Because there is no theoretically tenable basis for allocating joint costs and joint benefits of production among functionally defined outputs, the problem is one of developing as consistent a crosswalk as possible. How can allocations of cost be best made so that it is feasable to produce targets defined on the basis of functional analyses?

B.5. Total decision process

Analytical results serve only to define a "reasonable" starting point (Brandel 1978; Cooper and Zedler 1980) in planning and budgeting decisions. The influence of alternative types of information about WL/F on final decisions is poorly understood. This work would define the total decision process and its sensitivity to information more clearly so attention could be focused more sharply on critical data.

## Problem C. Limited Empirical Estimates

### C.1. Lack of feasible methodologies

This problem is really a subset of Problem A.1. Once a convincing case is made that WL/F values can be empirically defined, it is necessary to develop methodologies that are feasible to apply.

The requirements of cost in terms of dollars, time, and expertise and of the Office of Management and Budget to approve any questioning of users or the compilation of socioeconomic data (including place of residence) are formidable barriers to conducting traditional, primary-data studies. The only viable alternative is to construct regional travel cost models applicable to large geographic areas based on secondary data. A National Forest could be subdivided on the basis of counties, ROS land classes or big game management units, so long as users of those areas can be identified by place of origin. Adequate data are or can be easily collected through the agency's RIM and REC ZIP data systems and are already frequently available from state fish and wildlife agencies.

Cicchetti et al. (1976), Smith and Kopp (1980) and Bowes and Loomis (1980) have demonstrated that secondary data can be used to estimate demand functions for wilderness hiking, river rafting and big game hunting.[15] There seem to be few impediments to simultaneously compiling data for numerous activities for a given area, as proposed (but not yet achieved) by the Water Resources Council. If such a process were instituted for many forests, it would be possible to

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[15]There are situations where primary data are required to construct an "individual observation" model to avoid underspecification (Freeman 1979); on the other hand, such models tend to over-estimate demand functions because of systematic bias (Brown 1981).

determine whether the current, customized manipulation of data could be replaced by mechanically applied algorithms--that is, as a by-product it could be determined whether reproducable results can, in fact, be achieved through current methodologies.

C.1. Lack of hierarchical demand functions

Once subproblem C.1., above, is resolved, it will be possible to define Forest-specific demand functions. However, for planning it is also necessary to conduct economic analyses at Regional and national levels. The concept of an hierarchy of demand functions and the relationships among those functions has not been seriously addressed. Hoekstra (1978) pointed out the lack of geographic fit between local demands and the supply of migratory (e.g., salmon, waterfowl) animals. There is another poor fit between locally-defined values for recreation and national-market defined values for commodities. It is not clear that a regional or national demand function has any meaning if values are relevant only in separate locales.

C.3. Limited scope of measurement

To the extent that it is desirable to analytically treat WL/F management activities in planning and budgeting in the same fashion as activities of the timber, range, and recreation functions, limitations on the ability to define dollar-values are problems. Two limitations that now exist are: (1) the lack of one or a few common units of measurement, such as RVD's, AUM's or board feet, that would permit common analyses across many management activities, and (2) the definition of many WL/F management objectives in physical terms that cannot readily be related to users and measured in dollar-equivalents through the usual process of logical inference (e.g., Bowes and Loomis 1980). The usual recommendation to treat such faunal or habitat objectives as constraints

provides no guidance on allocations of limited funds among management objectives in different geographic areas, exacerbates the problem of functional accounting, and is not consistent with the agency's desire to develop a positive, rather than (apparently) reactive or negative, WL/F management program.

The two current approaches to explicit valuation treat the situation simply as a special case of problems where active users of the product can be defined. It is asserted that utility receivers can be identified and their actions or attitudes be used as the basis for valuation.[16]

In situations where recreationally or commercially important species are affected by habitat or faunal-directed activities, the most common approach is to define the value of recreational or commercial experiences (end-products) and then to input those same values to animals or habitat (e.g., Euler 1975).

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[16] Maler (1974) defined four possible approaches to defining the values of environmental goods or services: (1) define market purchases of complementary goods (e.g., travel for use), (2) ask people what goods or services are worth, (3) have people vote on the desirability of alternative conditions, and (4) establish market values of damages or replacement costs if certain conditions are not maintained or improved. The first two approaches are discussed here as explicit valuation techniques. The third is irrelevant except, possibly, as it is used to define the acceptability of tradeoffs. The last includes the opportunity cost approach discussed under Problem C-4 and extensions such as the calculation of capital replacement costs of nature's services (e.g., Gosselink et al. 1973). See Pearce (1976) for a discussion of logical limits of economic analysis when applied to pollution.

The second approach is to use the contingent value (questionnaire) methodology to define existence values, that is, citizens' willingness-to-pay for the knowledge that some condition exists (e.g., Randall et al. 1974).[17]

The first approach has the conceptual difficulty of imputing a full end-product value to just one of several factors of production and cannot provide a full measure of value when habitats or populations involve "minor" species. The questionnaire approach may suffer from a wide variety of weaknesses (Hof and Dyer 1981); it may not be possible to take advantage of a major claimed advantage of questionnaires, that of positing nonexisting situations (Brookshire and Crocker 1978), because of the difficulty of providing a precise image of habitat or faunal conditions to laymen.[18] While imputed-to-factor values have proven to be more-or-less acceptable in practice (by the Forest Service and others), considerable "selling" would be required before existence values were accepted as having analytic content in among-resources evaluations.

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[17]See Hof (1981) for a summary of the current conceptual development of the notion of unrevealed values. Option values are irrelevant in the current context for they are associated with possible future uses of end-products.

[18]After Schulze et al. (1981), it seems unlikely that there can be close-enough linkages between the conditions of interest, the institutional setting, and the data-collecting instrument.

The only known attempts to value endangered species (or unique conditions) have been both relative and normative. That is, valuation has only been attempted in the context of normative decision rules that put the burden-of-proof on nonpreservation. This has led to a sequential series of decision-rules that minimize the need for explicit valuation (generally after Bishop 1978):

1. if (net benefits of extinction) $\leq 0$, preserve;
2. if (net benefits of extinction) $\leq$ (net identifiable benefits of preservation), preserve;
3. if (net benefits of extinction) $\leq$ (net identifiable benefits of preservation) + (reasonable margin), preserve,
4. if delay in extinction is tolerable, try to develop technical substitute for extinction-related benefits or more complete knowledge of benefits of preservation; reapply rule 3; if "not preserve," proceed to extinction.

The first economic analysis after amendment of the Endangered Species Act invoked rule 1 to (indirectly) justify preservation. Ciriacy-Wantrup and Phillips (1970) invoked rule 2 regarding the California Tule elk. Holt and Talbot (1978) argue for rule 3. Viscusi and Zeekhouser (1976) discuss rule 4.

Given the needs of the planning and budgeting processes to aggregate descriptors of site-specific situations for centralized decision-making, it is important to expand the logical and empirical limits of explicit valuation to encompass as many situations not involving active users as possible.

C.4. Unknown cost/efficacy of standards

Given the state-of-the-art in wildlife biology and valuation, the most common approach in land management planning is to rely on constraints on the analytical decision space (e.g., Mealey and Horn 1981). The general approach and rationales of calculating opportunity costs are given by Brown (1981).

In essence, the implications of treating wildlife, fish and other resources in alternative ways are calculated and the "best" implications, based on some normative (outside-the-model) criterion, are selected and the underlying management activities initiated.

Although the details of how opportunity costs are calculated can vary, the same approach has been used with a variety of kinds of decision criteria. Most commonly in land management planning, the criterion is a technical judgment of whether minimum protective constraints would be met, that is, wildlife and fish resources are treated as constraining the production of explicitly valued commodity resources. A second criterion is whether public concerns ("public issues") related to wildlife and fish will be adequately satisfied. In this instance, public preferences are intuitively assessed to define "benefit," without being formally translated into explicit values.

The major tasks would be to define the constraints imposed on forest management to provide protection for WL/F and to develop a means of weighing the effectiveness of those constraints against the implied costs. Defining "effectiveness" is seen, in itself, as requiring a substantial research effort. This could be done in the context of the land management planning process through FORPLAN sensitivity analyses (see subproblem B.1., above) and for particular situations involving threatened, endangered, and sensitive species that are likely to lead to significant opportunity costs.

## Problem D. Inadequate Training and Communication

### D.1. Internal Training

Partly as a result of the nascent state of development of extramarket valuation techniques and partly as a result of the rapid expansion of planning activities and budget data requirements, coherent conceptual materials and standards of application of estimating procedures have not been provided to agency analysts (see problem A.1. above). At the same time, wildlife and fishery biologists, who must have enough understanding to explain the methodologies to their outside-the-agency peers, have been left to flounder. Both to develop reasonable estimates of value and to protect the credibility of agency procedures, it is necessary to prepare a substantial number of valuation-related documents and, most likely, to provide on-site instruction in their meaning and application.

### D.2. External Communication

There is a need to develop appropriately tailored written and verbal explanations for the agency's various clienteles. This includes scientific articles in the published literature, presentations to professional and special interest groups, and carefully constructed materials specifically written for state wildlife and fish agencies. This is a large undertaking that is necessary if others are to understand and be able to participate substantively in agency planning processes, as was intended in the passage of NEPA, RPA and NFMA.

## SECTION IV. DEFINING PRIORITIES FOR RESEARCH

### Criteria for Establishing Priorities

There are two major criteria that are relevant to establishing general[19] priorities for applied research focused on resolving or ameliorating the problems faced by NFS in planning and budgeting:

1. The significance of the problem and the utility of its resolution to a variety of agency staff units charged with planning and budgeting responsibilities, including:

   1.1. Wildlife and Fisheries Management Staff (WL).--Facilitating program management and functional planning and budgeting.

   1.2. Land Management Planning Staff (LMP).--Facilitating the completion of Forest and Regional plans.

   1.3. Resources Planning and Assessment and Program Development and Budget Staffs.--Facilitating analysis of national planning (RPA) and budgeting (PD&B) and acceptance in decision processes.

   1.4. Utility to other federal agencies and to state agencies with a strong interest in wildlife and fish resources.

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[19] Other relevant criteria that are not considered here are the availability of research resources, the probability of success, and the precise orientation of the Research Work Unit. See Appendix for a discussion of the administrative context of this Problem Analysis and an explanation of its format.

2. Forseeable contribution to knowledge, understanding of relationships, improvements in techniques, and to the general research and applied state-of-the-art.

## Ratings by Selected Criteria

In table 5, each of the identified problems is rated in terms of its operational importance and the likely contribution that work on its resolution would make to the state-of-the-art. The process used to develop these ratings was to (1) develop preliminary ratings on the basis of the author's experience and informal contacts with others, (2) distribute draft manuscripts to agency staff groups, other agencies, and individual scientists for their corrections of both problem identification and preliminary ratings, and (3) development of composite applied and state-of-the-art research priorities on the basis of those reviews by the author. The entire process was more subjective than was desired but probably was adequate for present purposes.

### Ratings by Importance/Utility to Staff Units

Ratings of importance/utility of problem resolution to WL, LMP, RPA and PD&B, and to other agencies with a strong interest in WL/F were developed from the perspective of enhancing the ability of those staffs to get their jobs done. That is why "Non-FS" agencies are shown as having no or limited interest in problems unique to the "FS system of doing things" but high interest in the development of convincing methodologies and in external (FS to them) communications. Similarly, RPA has a high interest in the development of hierarchal demand functions to support national analyses but a lesser interest in site-specific implications of protective standards.

Table 5.--Relative importance and priority ratings of identified problems in WL/F valuation[1]

| Identified problem | Importance/utility | | | | Composite applied research priority | State-of-the-art research priority |
|---|---|---|---|---|---|---|
| | WL | LMP | RPA PD+B | RPA Non-FS | | |
| A.1. Lack of convincing methodologies | High | High | High | High | High | High |
| B. Incomplete understanding of current procedures | | | | | | |
| 1. LMP values and treatment | High | High | Med | Low | Med | Low |
| 2. Commensurability of current values | High | High | High | Med | High | Med |
| 3. Variation in field data | High | Low | Med | 0 | Low | 0 |
| 4. Integrated/functional linkages | High | High | High | 0 | High | 0 |
| 5. Total decision process | High | Med | Low | 0 | Low | Low |
| C. Limited empirical results | | | | | | |
| 1. Lack of feasible methodologies | High | Med | Med | Med | High | Med |
| 2. Lack of hierarchal demand functions | Low | Med | High | Low | Med | High |
| 3. Limited scope of measurement | High | 0 | Low | Med | Med | Med |
| 4. Unknown cost/efficacy of standards | High | High | Low | Med | High | Low |
| D. Inadequate training, communication | | | | | | |
| 1. Internal training | Med | Low | Low | 0 | Low | 0 |
| 2. External communications | High | High | Low | High | High | 0 |

[1]See text for general explanations. Relative ratings are most meaningful within columns.

The fifth column of table 5 is intended to be a composite of the ratings in the first four columns. Because it is not possible to say that a high rating by one staff reflects a greater absolute importance to the Forest Service as a whole than a medium rating by some other staff, the ratings were not always averaged. In general, the rating by WL was given a somewhat greater weighting than the others.

These composit ratings are appropriate for a program of highly applied research in WL/F valuation.

Ratings by Contribution to State-of-the-Art

In contrast, the ratings in the last column are appropriate for a program in WL/F valuation that heavily stresses improving the state-of-the-art through development of logical thought, hypothesis formulation and testing, and the development of applied methodologies. While some of the elements of Problems B and D are extremely important in an applied sense, their resolution is more likely to satisfy institutional needs than to appreciably advance the state-of-the-art.

Of course, in the presence of imagination work primarily focused on institutional problems can have numerous payoffs. That is why a medium rating is given to problem B-2; essentially no research has dealt with large quantities of "real" data in defining what are and what are not commensurable values.

## Recommended Research Priorities

The assumption that is made here is that a balance is sought in conducting research to both help resolve immediate problems and to advance the state-of-the-art so future problems will be less severe or avoided entirely.

No attempt has been made to include in the recommended priorites those problems which result principally from institutional procedures rather than from shortcomings in the state-of-the-art. That is not to say they are not important, for the manner of linking integrated and functional analyses (B-4) is among the most serious analytical questions facing the agency and inadequate communications about analytical procedures is a pervasive problem.

The discussions of individual problems in Section III generally outline the kinds of work required in each of the following.

Priority 1.--Develop scientifically credible and generally acceptable valuation methodologies (A-1).

This work is so important that, without it, any other work related to extramarket resource valuation will be of sharply limited utility.

Priority 2.--Define criteria for ensuring commensurability among values of different resources and test current estimates against those criteria (B-2).

Priority 3.--Develop valuation methodologies that are feasible for implementation throughout NFS while deviating as little as possible from ideal methodologies (C-1).

Priority 4.--Define the logical and empirical relationships among local, regional and national demand functions and develop techniques for aggregation and disaggregation (C-2).

Priority 5.--Develop standard techniques to quantitatively compare the opportunity costs to the efficacy of WL/F protective standards (C-4).

Priority 6.--Define the logical limits of explicit valuation of WL/F resources when active users cannot be identified (C-3).

Priority 7.--Define the sensitivity of analytical models to the explicit and implicit expressions of value of WL/F used in land management planning (B-1).

Priority 8.--Define, and determine the sensitivity to alternative expressions of WL/F values of, the total planning decision process (B-5).

# LITERATURE CITED

Bishop, R. C. 1978. Endangered species and uncertainty: the economics of a safe minimum standard. Amer. J. Agr. Econ. 60(1):10-18.

Bishop, Richard C. and Thomas A. Heberlein. 1979. Measuring values of extramarket goods: are indirect measures biased? Amer. Jour. Agricultural Economics 61:926-930.

Bowes, M. and J. Loomis. 1980. A note on the use of travel cost models with unequal zonal populations. Land Economics: November.

Brandel, J. E. 1978. Evaluation and politics. Evaluation (Special Issue):6-7.

Bookshire, David S. and Thomas D. Crocker. 1978. The use of survey instruments in the economic valuations of environmental goods: an assessment. Paper presented to ERDA 9 Environmental Aesthetics Symposium on April 15, 1978, University of Arizona, Tucson. 27 p. (mimeo.)

Brown, Thomas C. 1981. Tradeoff analysis in local land management planning. USDA For. Serv. Rocky Mtn. For. and Range Exp. Sta. Gen. Tech. Rep. RM-82. Fort Collins, Colo. 12 p.

Brown, William (Oregon State Univ.). 1981. Personal communication.

Cicchetti, C., A. Fisher and K. Smith. 1976. An econometric evaluation of a generalized consumer surplus measure: the Mineral King controversy. Econometrica: November.

Circiacy-Wantrup, S. B. and W. E. Phillips. 1970. Conservation of the California Tule elk: a socioeconomic study of a survival problem. Biolog. Conserv. 3:23-32.

Cooper, C. G. and P. H. Zedler. 1980. Ecological assessment for regional development. Jour. Environ. Manage. 10:284-296.

Cortner, Hanna J. and Dennis L. Schweitzer. 1981. Institutional limits to national public planning for forest resources: the Resources Planning Act. Natural Resources Jour. 21:203-222.

Cortner, Hanna J. and Dennis L. Schweitzer. (In process) The political nature of quantitative models in local public forest planning. In Proc., IUFRO World Congress, Sept. 1981, Kyoto, Japan.

Euler, D. 1975. The economic impact of prescribed burning on moose habitat. Jour. Environ. Manage. 3:1-5.

Freeman, M. 1979. The benefits of environmental improvement. Johns Hopkins Univ. Press, Baltimore, Maryland.

Gosselink, J. G., E. P. Odum and R. M. Pope. 1973. The value of the tidal marsh. Paper LSU-SG-74-03. Center for Wetland Resources, Louisiana State Univ., Baton Rouge. 23 p. (mimeo.)

Gum, R. L. and W. E. Martin. 1975. Problems and solutions in estimating the demand for and value of rural outdoor recreation. Amer. Jour. Agr. Economics 57(4):558-566.

Hoekstra, Thomas W. 1978. The need for nontimber product resources. In Distinguished Lecturer Series. F. L. Newby (ed.) Misc. Rep. 207, Agr. Exp. Sta., Univ. Maine, Orono. p. 71-79.

Hof, John G. 1981. Report on unrevealed values workshop held in Kalamazoo, Mich., 6/8-6/10/81 (plus attachments). Internal letter to Thomas Hoekstra, file 1360 of 6/24/81, USDA For. Serv. Rocky Mtn. For. Range Exp. Sta., Fort Collins, Colo.

Hof, John G. and A. Allen Dyer. 1981. An evaluation of the state-of-the-art in outdoor recreation supply and demand analysis for multiple use land management agencies. USDA For. Serv. Rocky Mtn. For. Range Exp. Sta., Fort Collins, Colo. (draft report)

Holt, S. J. and L. M. Talbot. 1978. New principles for the conservation of wild living resources. Wildlife Monograph 59, Wildlife Society. 30 p.

King, David A. and Ann W. Walka. 1980. A market analysis of trout fishing on the Fort Apache Indian Reservation. Final Report, School of Renewable Natural Resources, Univ. Arizona, Tucson. 86 p. (mimeo.)

Maler, K. G. 1974. Environmental economics: a theoretical inquiry. Johns Hopkins Univ. Press, Baltimore, Maryland.

Mealey, S. P., and J. R. Horn. 1981. Integrating wildlife habitat objectives into the forest plan. In Proceedings, No. Amer. Wildl. Natur. Resourc. Conf. (in process).

Meyer, Philip A. 1979. Publicly vested values for fish and wildlife: criteria in economic welfare and interface with the law. Jour. Land Economics 55(2):223-235.

Pearce, David. 1976. The limits of cost-benefit analysis as a guide to environmental policy. Kyklos 29 (Fasc. 1):97-112.

Randall, Alan, Berry Ives and Clyde Eastman. 1974. Bidding games for valuation of aesthetic environmental improvements. Jour. Environ. Econ. Manage. 1:132-149.

Schulze, William D., Ralph C. d'Arge and David S. Brookshire. 1981. Valuing environmental commodities: some recent experiments. Land Economics 57(2):151-172.

Schuman, H. and M. P. Johnson. 1976. Attitudes and behavior. Annual Rev. Sociology 2:161-207.

Schuster, Ervin G. 1977. Investment analysis: problems and prospects in recreation, wildlife and fishery management. In Outdoor Recreation: Advances in application of economics. Jay M. Hughes and R. Duane Lloyd (eds.) USDA Forest Service Gen. Tech. Rep. WO-2. Washington, D.C. p. 133-139.

Schweitzer, Dennis L. 1980. Wildlife values information--Forest Service requirements and availability. In Wildlife Values, W. W. Shaw and E. V. Zube (eds.). Institutional Series Rept. No. 1, School of Renewable Natural Resources, Univ. Arizona. p. 91-98.

Schweitzer, D., W. Brown, F. Everest, C. Hansen, G. Jones, T. Roettig, E. Schuster, and F. Kaiser. 1980. Defining recreational values dependent on wildlife and fish to be used in Regional and Forest land and resource management planning. Resources Planning and Assessment Staff, USDA Forest Service, Washington, D.C. mimeo. 36 pp.

Schweitzer, Dennis L., Thomas W. Hoekstra, and Charles T. Cushwa. 1981. Lessons from past National assessments of wildlife and fish--information and coordination needs for the future. In Proceedings, No. Amer. Wildl. Natur. Resourc. Conference (in process).

Smith, K. and R. Kopp. 1980. Spatial limits of the travel cost recreational demand model. Land Econ: Feb.

Smith, Nancy E. 1980. A comparison of the travel cost and contingent valuation methods of recreation valuation. MS Thesis, Dept. Ag. and Res. Econ., Oregon State Univ., Corvallis. 74 p.

Society of American Foresters. 1981. The RPA process--1980: report summary of the task force on RPA implementation. Jour. Forestry 79(6):insert following p. 382.

Viscusi, W. K. and R. Zeekhouser. 1976. Environmental policy choice under uncertainty. J. Environ. Econ. and Manage. 3:97-112.

# APPENDIX

## Administrative Context of Problem Analysis

The general mission of the National Resource Analysis Techniques Research Work Unit (RWU) is defined as:

> "Develops new and improved techniques for national, regional, and state analyses of the entire forest and rangeland renewable resources as a basis for renewable resource assessments/appraisals, resource program development and delivery, and land management planning."

This document is Part B of the Problem Analysis for the third of five Problem Areas assigned to the RWU for resolution:

> Problem area 3: Develop techniques to support national assessments of wildlife and fish.

Part A of this Problem Analysis is entitled Ecological Analysis Techniques for National Assessments of Wildlife and Fish. It deals with the definition of biological production functions and effects on wildlife and fish of deliberate and inadvertent physical changes in the land and water resource base.

There is also a direct tie to a second Problem Analysis (Problem Area 4, this RWU) entitled Integrated Resource Analysis for National Assessments. That document addresses the data transfers and analytical techniques that are necessary at each hierarchal level if there is to be an adequate basis for local and national program development, where "adequate" is defined as meeting the legal requirements of the Resources Planning Act as amended by the National Forest Management Act.

As implied in the RWU mission statement, resource assessments, program development and delivery, and land management planning are intricately bound together within a specific institutional decision framework for any particular land-managing, natural resources agency. The only such agency in the United States that has explicitly defined legal mandates to perform all of the specified activities at both local and national levels is the USDA Forest Service. (The principal laws are the Forest and Rangelands Renewable Resources Planning Act of 1974 and the National Forest Management Act of 1976.) Much of this work is the responsibility of the National Forest System branch, which is directly responsible for the resources, conditions, and uses occurring on 187 million acres of lands and waters.

Because this Problem Analysis focuses on the specific decisionmaking environment of the Forest Service, not all of the discussion and findings will be applicable to other agencies that perform their functions in a somewhat different context. On the other hand, some of the "neutral" problems, such as limitations on analytically dealing with faunal and habitat goals of WL/F management, will be of general applicability. In establishing research priorities, explicit recognition is given to the potential value to other agencies of resolving each problem.

An attempt has also been made to judge the contribution to the state-of-the-art of WL/F valuation likely to result from working on each problem. However, the present Problem Analysis differs from other, less applied efforts by focusing primarily on the value of facilitating institutionally-defined processes.

The traditional "bottom line" of Problem Analyses is an explicit definition of available research resources and their assignment to specific studies for some number of years (usually five) into the future. However, in this document only general research priorities are defined. The reason is that responsibilities of this RWU recently have been redefined and a new RWU, with unpredictable resources, will soon be initiated to focus exclusively on research into the valuation of forest resources.

Given this circumstance, and the fact that most of the identified problems apply to all extramarket resources, it is likely that those who actually conduct the research will wish to define specific studies and their sequencing. Therefore, while the general types of work necessary to resolve the identified problems are discussed in Section III, more specific defintions are left to the scientists in the new RWU.